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ABSTRACT

This student module on safety practices for demolition procedures is one of 50 modules concerned with job safety and health. This module presents a general outline of the safe work practices that should be followed at a demolition job site in order for workers to avoid injury. Following the introduction, 10 objectives (each keyed to a page in the text) the student is expected to accomplish are listed (e.g., Discuss the removal of debris from the demolition site). Then each objective is taught in detail, sometimes accompanied by illustrations. Learning activities are included. A list of references and answers to learning activities complete the module. (CT)

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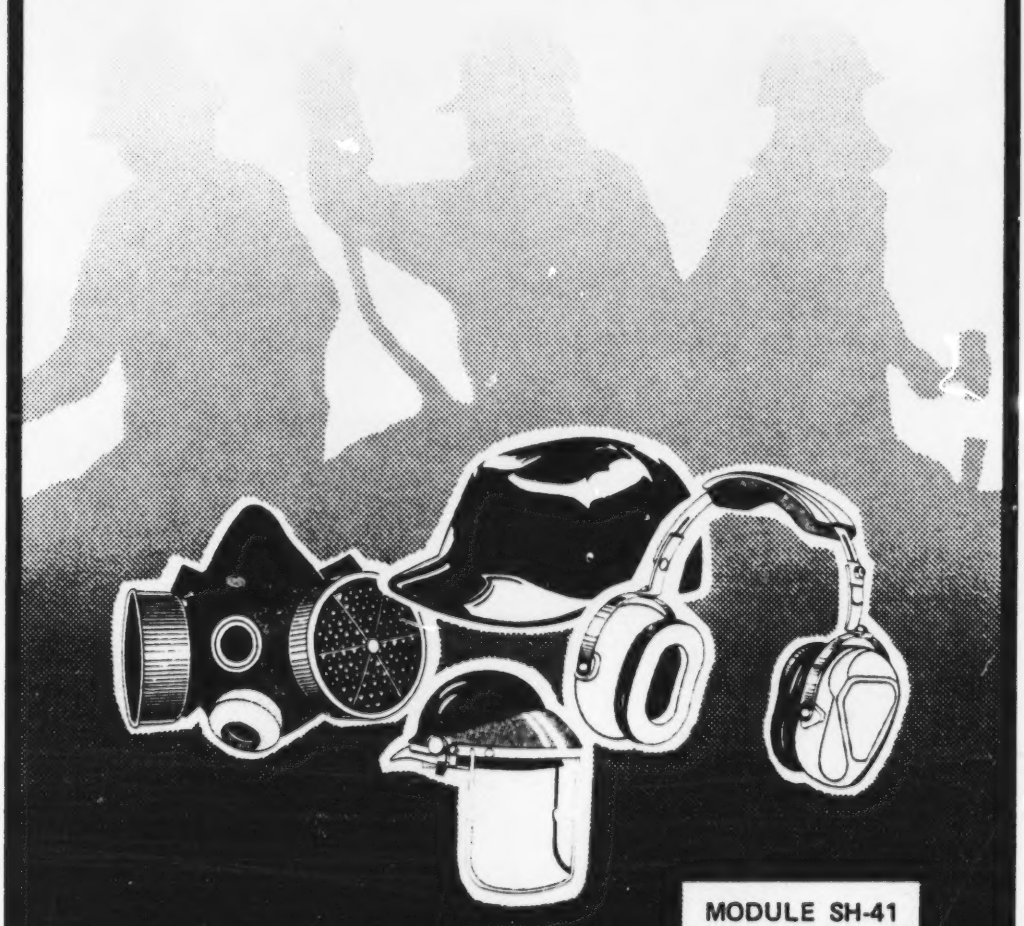
SAFETY AND HEALTH

SAFETY PRACTICES FOR DEMOLITION PROCEDURES



MODULE SH-41

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INTRODUCTION

Demolition, the act of tearing down, is one of the specialized construction trades requiring experienced personnel with specific expertise. Demolition can be a very hazardous occupation; the combination of heavy equipment and debris often creates dangerously congested work areas. Even on minor demolition jobs, the potential exists for accidents from lifting, using tools, falling, or be struck by falling debris.

A recent survey showed that there are approximately 2500 companies involved in demolition work in the United States; together they employ nearly 50,000 workers. Most of these companies are small, having 5 to 10 permanent employees and relying on temporary employees for the bulk of their work force. These temporary employees are often untrained and do most of the manual labor. Thus, they are also more likely to become injured than other demolition workers.

This module presents a general outline of the safe work practices that should be followed at a demolition job site in order for workers to avoid injury and to do the job well.

OBJECTIVES

Upon completion of this module, the student should be able to:

1. Define minor demolition as related to at least three specific structural characteristics including size, structural makeup, and location. (Page 3)
2. Identify three pre-demolition activities that must be carried out before minor demolition projects begin. (Page 4)
3. Describe the sequence of, and requirements for removal of the various structures and parts of a building being demolished. (Page 6)
4. Discuss the removal of debris from the demolition site. (Page 10)
5. Cite restrictions concerned with workers conducting activities above other workers and the use of personal protective equipment. (Page 13)
6. Compare major and minor demolition by definition, pre-demolition activities, and structural preparation. (Page 17)

7. Describe the special requirements for floor openings, stairs, passageways, ladders, and chutes. (Page 19)
8. Discuss briefly the removal sequence during demolition. (Page 22)
9. List debris storage requirements during demolition. (Page 23)
10. Describe the process of demolition for steel structures, including the use of mechanical equipment and explosives. (Page 24)

OBJECTIVE 1: Define minor demolition as related to at least three specific structural characteristics including size, structural makeup, and location.

Many factors influence the demolition method selected to bring a structure down. The age, type of construction, size, location, and condition of a structure influence the choice of methods used to demolish it.

In this module, demolition activities are divided into two categories: minor and major. Although many of the work practices outlined are the same for both categories, dividing the module into two parts allows for a clearer explanation of methods used on different types of structures. Regardless of the type of structure or of the method used to demolish it, safety in demolition is a combination of common sense and a willing attitude toward using that common sense.

Minor demolition is defined as the wrecking or destruction of a structure 25 feet or less in height and not over three stories high. Examples of these types of structures include houses, small apartment buildings, motels, commercial properties, barns, silos, warehouses, or small structures at industrial facilities. Both a house that is severely damaged by fire and an old wooden building in the right-of-way of a highway project would be considered minor demolition jobs.

The minor demolition structure may be constructed of brick, wood, stone, or sheet metal, with interior walls of plaster, plywood, drywall, or a combination of other building materials. In most cases, the structure does not contain any reinforced concrete or structural steel. Reinforced concrete is cement material strengthened by encasing bars of steel within it; structural steel is used as the strong metal framework of a building. These materials are used in structures that have to carry a great deal of weight or very heavy loads, such as tall office buildings or industrial plants.

Usually, the building categorized as a minor demolition structure is free standing; that is, it is not part of or directly adjacent to any structure that is to be maintained. In exceptional cases, such as row housing, special precautions must be taken.

ACTIVITY 1:*

(Mark these statements true or false.)

_____ 1. All minor demolition structures are free standing.

_____ 2. Minor demolition involves buildings 25 feet or more in height.

_____ 3. Procedures for minor and major demolition are in no way similar.

_____ 4. Minor demolition structures usually do not contain reinforced concrete or structural steel.

OBJECTIVE 2: Identify three demolition activities that must be carried out before minor demolition projects begin.

Several preparatory activities must be undertaken before any demolition activity may begin. The first of these tasks is restriction of the area. Demolition is usually performed on old, dilapidated structures that are being torn down because they are useless or represent a hazard to the general public. For their safety, the public should be kept well away from the structure. This can be accomplished through the use of signs, barricades, jobsite lighting, and fencing.

Signs must be erected to announce to the public the hazards that exist at the job site. Familiar standardized signs are the most effective. DANGER signs should be used only when an immediate hazard exists, such as an open hole. CAUTION signs are to be used to warn against potential hazards. EXIT signs indicate passageways to safety. Other useful signs point out the presence of heavy equipment such as trucks and bulldozers at the job site, or advise the public that men are working above them. Proper use of warning signs is important at all demolition job sites.

*Answers to Activities appear on page 27.

Before any demolition work is started, every sidewalk or public thoroughfare adjacent to the job site must be closed, relocated, or protected. Thoroughfares used by the public must be kept clear, clean, and unobstructed at all times.

Whenever possible, pedestrian and vehicular traffic should be prohibited from using any area that is closer to the perimeter of the structure being demolished than one-fourth (1/4) of the height of the structure. If it proves impossible to do this, such as in highly urbanized areas, a substantial sidewalk shed must be constructed over the length of the public-use route that is near the structure. This sidewalk shed must be wide enough to accommodate pedestrians without causing congestion, and it must receive sufficent light to ensure their safe passage. The roof of the sidewalk shed must be at least eight feet high, built of sound planking not less than two inches thick, and capable of sustaining a load of 150 pounds per square foot. The supporting members of the sidewalk shed must be adequately braced. A solid fence, constructed of wood or other stable material, must be created on the shed's inside face to run the full height and length of the shed.

When pedestrian traffic is required to use an area other than an existing sidewalk and that area is at a greater distance from the perimeter of the structure being demolished than one-fourth (1/4) the height of the structure, then a clearly marked temporary walkway may be constructed in place of a sidewalk shed. This temporary walkway must consist of a solid fence running the length of the sidewalk area on the inner side, and a continuous railing on the street side.

A second activity that must be carried out prior to demolition is an engineering survey. This survey is conducted to determine the type and condition of the framing, floors, and walls of the structure. It is performed in order to prepare for the demolition work, to plan for the necessary equipment, and to take measures that will prevent premature collapse of any part of the structure. Surrounding structures should be surveyed to ensure their protection, and the land itself should be inspected for soil condition, trees to be saved, and salvageable items.

The engineering survey should also locate all basements or cellars, since in some older houses these lie beneath the pavement and if too much weight is

placed on them, they can be hazardous. The position, depth, and type of any well should be located during the survey, and wells should be sealed or fenced for protection. Inquiries should be made to determine, if possible, the prior uses of the structure to be demolished. In this way, a judgement can be made regarding the presence and handling of any hazardous materials that may be in the structure. Since the engineering survey serves as the master plan for the demolition job, it will list the workers, equipment, safety devices, and other materials necessary to perform the job well.

The third preparatory activity involves the location and disconnection of all utilities to the structure. This is vitally important in order to safeguard all workers at the site. All electric, gas, water, steam, sewer, and other service lines must be shut off, capped, or otherwise controlled either at or outside the building line, before demolition work is started. In each case, the utility companies must be notified in advance, and their approval, directions, or disconnection services must be obtained. If it is necessary to maintain power, water, or other utilities at the site during demolition, these lines must be temporarily relocated or otherwise sufficiently protected from damage.

ACTIVITY 2:

Identify three pre-demolition activities that must be accomplished before minor demolition projects begin.

1. _____
2. _____
3. _____

OBJECTIVE 3: Describe the sequence of, and requirements for removal of the various structures and parts of a building being demolished.

Once the pre-demolition activities cited above have been completed, the actual wrecking of the building can proceed. Each of the activities involved in this phase of demolition will have numerous hazards, such as fragments,

dust, falling debris, and weak supports. The personal protective measures and equipment to provide the worker with the maximum amount of safety is discussed under Objective 5 in this module.

The first activity in the actual wrecking of a building is the removal of glass. The glass is removed from the building to prevent workers being injured by fragmentation of the glass at a later stage. This work may be performed with a hand tool such as a sledge or maul, or may involve the removal of the entire window, including the frames and sills.

All lathing and plaster should be stripped off throughout the building, to prevent excessive dust when the more substantial portions of the structure are later removed. This stripping work can be accomplished with a hand tool, such as a sledge or crowbar, and water should be used to reduce the dust produced.

A few precautions should guide workers in the use of hand tools. When using a sledge or maul, watch where you swing it! Make sure that tools are in good repair; check for damaged handles and loose heads. Workers who neglect proper storage of tools that are not in immediate use are contributing to tripping and falling accidents. Leaving a tool "out" is a simple and a common error, but the consequences of such carelessness may be serious. More information concerning the safe use of hand tools can be found in Module SH-19 entitled, "Safety with Hand and Portable Power Tools."

It may be necessary to temporarily reinforce a wall or floor that will eventually be torn down, in order to protect workers on the site. All such walls and floors should be strengthened by braces or shoring.

All chimneys must be removed from the structure. Chimneys should be the subject of especially careful inspection during the initial survey before work is started. Particular attention should be paid to the condition of the mortar between the brickwork. If it is badly deteriorated, the chimney can collapse prematurely. Demolition of a chimney should be accomplished by hand from a working platform supported by a self-support scaffold. Demolition should proceed course by course, the debris being dropped outside the shaft. Debris should not be allowed to accumulate inside the shaft of the chimney since such debris may put pressures on the base of the chimney and cause it to collapse. No other workers should be permitted to work near the area where a chimney is being demolished.

The removal of a roof can be a very hazardous part of demolishing a structure. In old, deteriorating structures, the roof, which has borne the brunt of weather and wear over the years, may be very weak. Beams and rafters may be rotted or loose therefore, care must be exercised. Demolishing a roof should be carried out in the reverse order of the method by which it was erected. First, ensure that any weakened members are adequately braced or shored. Then remove the shingles and tar paper with hand tools. Next, strip off the roof sheathing. This material may be plywood panels or slats of wood called roofers; roofers found on older structures are often of tongue-and-groove construction. When the sheathing has been removed, the rafters can be taken down. Remove the rafters in opposite pairs, starting with the sets that are one in from each end of the roof, pass them down to the next floor level for disposal. Some roofs may have collar beams (supports that add stability to the rafters), and these should be removed with each set of rafters. After a sufficient number of the rafters have been removed, the main structural member of the roof, the ridgebeam or ridgepole, may be taken down. In some instances, this ridgebeam may be in 10 foot sections, in which case it may be removed in sections with the rafters. If, as in some older structures, it is a solid one-piece beam, it may be cut down in sections, using a saw. The ridgebeam should be well supported during rafter removal to prevent premature collapse of the roof. Roof material should never be thrown over the side of structure; it should always be passed down to the next floor for proper disposal.

The walls of the structure may be removed from either the inside or outside, with the debris being removed through chutes to ground level. Care should be taken that the floors are strong enough to stand the weight of the debris. Removing the walls from outside the structure requires the use of scaffolds. Scaffolding is categorized by the maximum safe load it can support in terms of platform areas:

- Light-duty scaffold — 25 pounds per square foot.
- Medium duty scaffold — 50 pounds per square foot.
- Heavy-duty scaffold — 75 pounds per square foot.

Light-duty scaffolds are intended only to support workers, not material or debris. Be careful to avoid overloading a scaffold in all cases. Make sure there is an even distribution of the load to avoid tipping.

There are several general rules to follow when using a scaffold:

1. Always check the scaffold before use. Make sure all the parts are in good condition, free from cracks or rust.
2. An experienced person should supervise the erection of all scaffolds.
3. Check the soil on which the scaffold is built in order to avoid tipping.
4. Make sure the scaffold is level. Check it often during the work.
5. Anchor the scaffold at least every 30 feet in length.
6. Keep the scaffold free of litter, debris, oil, or grease.
7. Planks must be laid with the edges close together and be free of any cracks or defects. Plank ends must not extend more than 12 inches nor less then six inches beyond the ends of the scaffold.
8. All scaffolds must have guard railing consisting of a top rail, intermediate rail, and a toeboard (see Figure 1).

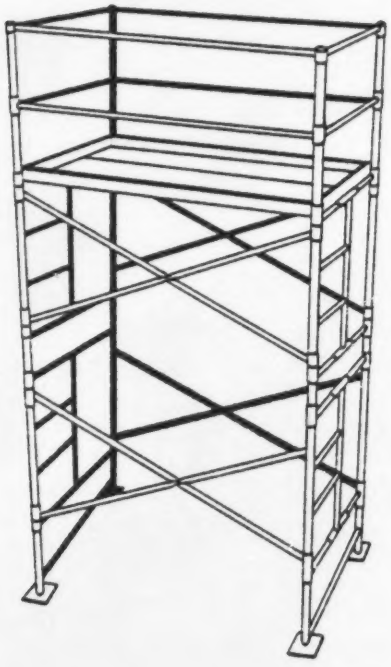

Figure 1. Scaffold.

As with a roof, the walls of a structure can be demolished in the reverse order of that in which it was erected. Walls may normally be taken down uniformly, story by story, using hand tools such as a sledge or maul. In some cases, a jackhammer may be used. The material may be pushed into the interior of the structure, making sure not to overload the flooring. Workers must not be working on the floors below any wall demolition. Periodic removal of debris is required to prevent too much weight building up on floors. This creates lateral

pressure (pressure coming from the side) on the lower parts of the wall and causes premature collapse.

ACTIVITY 3:

Number the items below to show the order in which building parts should be removed on a minor demolition job.

__ Remove lath and plaster.
___ Remove glass.
___ Remove walls.
___ Remove roof.
___ Remove chimneys.

OBJECTIVE 4: Discuss the removal of debris from the demolition site.

A common risk in demolition is the unintentional overloading of part of the structure by the accumulation of debris from parts already demolished. Debris should not be allowed to build up on floors or on other parts of the structure, since this can overload and endanger it. Debris also constitutes a tripping and falling hazard, so it should be removed from the inside of a structure by chutes (see Figure 2). Where possible, these chutes may dump directly into a dumpster or debris receptacle for easy removal to a proper disposal site.

When chutes are not practical, care must be taken to ensure that all debris storage areas are kept clear of workers. For this purpose, the areas should be barricaded off. If debris is passed down through floor openings, these openings must have curbs or bumpers to prevent equipment such as wheelbarrows from running over the edge.

The buildup of debris on the ground floor level can impose side loads on the lower story walls. Therefore, regular clearing of debris is essential, and during these clearing operations, all dropping of material should cease.

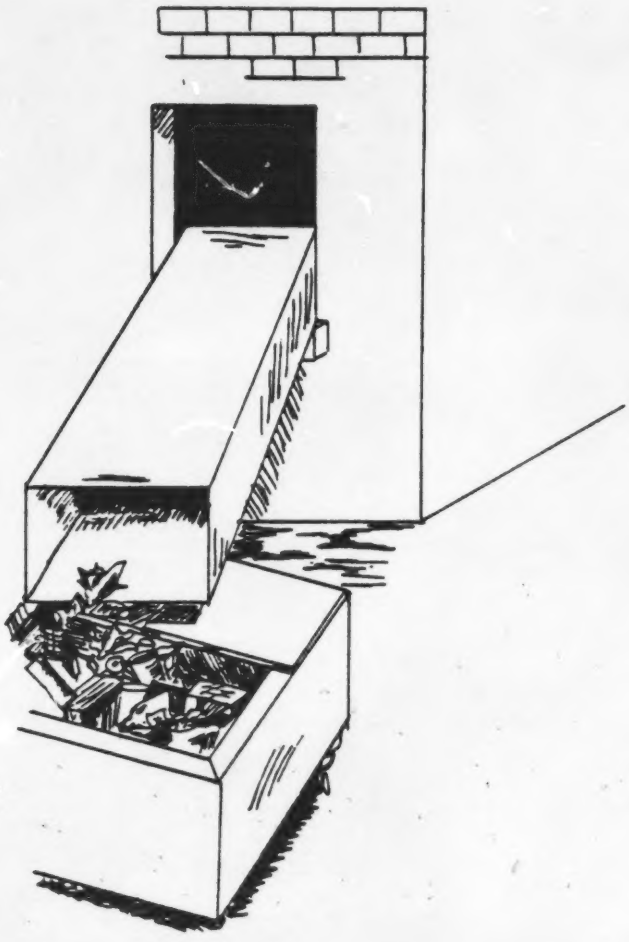

Figure 2. Chute for debris removal.

Debris removal operations conducted inside the walls of a structure are usually accomplished through floor holes. When they are available, existing floor holes such as elevator or ventilation shafts should be used for this purpose. In any case, floor holes must not take up more than 25 percent of the total floor area on each level. Warning signs must be posted on each floor having an opening for debris removal, and floor holes must be enclosed by a bumper four inches wide and six inches high. All floor holes not in use should be covered with planks that have been secured to prevent movement. Debris clearing operations on the bottom floor must not begin until all dumping has stopped. When loading debris into a truck for removal from the demolition job site, special care should be taken not to overlaod the truck, since overloads can contribute to driving accidents.

"Overloading" can happen to people, also, and debris removal involves some lifting and carrying. When lifting, use the approved method outlined below:

- Size up the load first, before you try to lift it. If the load looks too heavy or awkward, get help.
- Do not try to lift too much yourself.

- Squat close to the load you are going to lift. Keep your back straight.
- Get a good grip on the load.
- Lift with your legs, smoothly and evenly, keeping your back straight.
- Pace yourself. Do not try to carry the load too far.
- Squat to set the load down. Do not twist your body.
- Remember — lift with your legs, not your back.

Storage areas for debris should be set up outside the walls of any structure being demolished. As discussed earlier, debris should never be allowed to accumulate in the work areas because it represents a hazard to workers and an unattractive nuisance to the general public. Storage areas should be located in open areas on the job site to allow for easy access by machinery when final removal is begun. The storage areas should be blocked off by barricades. These barricades may be of the horse type and should be highly visible. The storage area should be kept closed at all times when debris is not being removed, and the area should be inspected at least daily for fire or other hazardous conditions.

ACTIVITY 4:

1. List two reasons why debris must not be allowed to build up in buildings that are being demolished.
   a. _____
   b. _____
2. Name two means of removing debris from a structure that is being demolished.
   a. _____
   b. _____

OBJECTIVE 5: Cite restrictions concerned with workers conducting activities above other workers, and the use of personal protective equipment.

When work is being conducted on several levels of stories at a demolition site, extra care is required. Workers on scaffolds must be careful to push debris inside the structure, since debris falling outside the structure could injure other workers on a lower level. Debris should not be allowed to accumulate on scaffolds since it could easily fall onto workers below. When working above others on the job site, workers should also keep a watchful eye on their tools.

When work is being performed above an access to a structure, a canopy able to withstand a load of 150 pounds per square foot should be constructed to ensure safe entry.

Guard railing consisting of a top rail, an intermediate rail, and a toeboard must be provided on all open sides and ends of elevated working platforms. The top rail must be at least 42 inches high, and should be of at least two by four inch lumber or the equivalent. The intermediate rail should be made from one by six inch lumber or its equivalent, and must be installed about halfway between the top rail and the platform surface. The toeboard should be at least four inches high, and adequate screening should be used between the toeboard and top guard rail where there is danger of materials falling from the platform. Support posts for guard rails should be spaced not more than eight feet apart.

Fall protection devices such as lifeline systems and safety nets must be provided for workers on demolition job sites. Lifeline systems consist of a safety belt that is worn around the waist, a lanyard (a short piece of rope or webbing), and a lifeline which is connected to a secure part of the structure. Safety nets, extending out at least eight feet beyond the work surface, may also be used.

Hazards in demolition work are numerous, and range from sharp edges on debris to exposure to hazardous chemicals. Personal protective equipment is designed and worn to protect the worker from these hazards. Protective equipment includes safety glasses, face shields, hard hats, safety-toe boots,

respiratory devices, and proper clothing. This equipment must be provided and used wherever it is necessary.

Eye and face protection devices consist of safety glasses, goggles, face shields, welding goggles, and welding helmets (Figure 3). Safety glasses and

a. b. c.

Figure 3. Personal eye protection devices.

goggles are designed to protect the eyes from dust, flying particles, sparks, and splashing liquids (Figure 3a). Face shields provide the same protection but are usually worn over safety glasses or goggles in order to protect the full face (Figure 3b). Welding goggles and helmets are used by all workers engaged in welding and cutting, and by all workers assisting in these activities (Figure 3c).

Figure 4. Hard hats.

The use of "safety" or "hard" hats is required for all workers on the job site (Figure 4), since they protect against head injuries caused by falling objects or debris and by bumping one's head. Hard hats should always be worn by everyone at a demolition job site,

regardless of a person's activities.

Foot injuries are common in demolition work; therefore, safety shoes must be worn on these job sites. Safety shoes should have thick soles and steel toes to protect against nail punctures and injuries from the dropping of material on the foot. Safe footwear is essential, so street shoes, sneakers, or other unsafe shoes must never be worn by demolition workers.

The use of respirators is required whenever workers enter areas that are dusty, deficient in oxygen, or that contain hazardous airborne contaminants. Respirators must be carefully selected to match the environment in which they are to be used. Disposable, single-use respirators offer good protection in dusty areas. Cartridge respirators that use cartridge filters to purify the air are good for dusts, fumes, and gases. Powered, air-purifying respirators contain a blower that passes contaminated air through a filter where the contaminants are removed. These respirators are approved only for dusts, fumes, or gases specified on the filters. Self-contained breathing apparatus involves the use of an air supply tank carried on the user's back, similar to scuba equipment used by divers. These respirators are used in oxygen-deficient areas such as tanks. Remote air-supplied respirators draw from a central source of clean air that is pumped to the worker through a supply line (see Figure 5).

Besides ordinary dusts, certain hazardous materials may be present on the demolition job site. Asbestos, long used in construction for its thermal and electrical insulating properties, constitutes a real danger to health when it is present in friable (easily crumbled) form. Although engineering controls (such as dust collections) and good work practices (such as wetting down asbestos during demolition to keep it from becoming airborne) can substantially reduce the risk of asbestos exposure, respiratory protection and protective clothing are also required to ensure worker safety. Specific permissible levels of exposure to asbestos have been set by OSHA (Occupational Safety and Health Administration), and when the concentration of asbestos fibers exceeds those levels, protection must be selected and provided.

Demolition workers sometimes encounter PCBs (polychlorinated biphenyls); these are organic chemicals often found in transformers and capacitors. PCBs have been identified as potentially cancer-causing. Exposure to PCBs can occur through attempts to drain transformers for salvage, or from spills from

Figure 5. Respiratory safety devices.

old or damaged transformers. Protective clothing and respirators are required in work areas where PCBs are present and have not come under control through engineering or other precautionary measures.

All workers must be trained in the proper use and maintenance of respirators. It is essential for personal protection that the correct respirator be selected for each individual situation, since the wrong respirator can be worse than no respirator at all.

Safe work clothing should be worn by all demolition workers. Work clothes should be free from oil and grease and should fit well so that they do not get caught in debris or machinery. Jewelry should not be worn on the demolition job site, as it could also catch in machinery or materials and cause injury. Good, general duty gloves should also be worn by demolition workers. Special clothing may be required for the handling of hazardous

materials. Government standards should be checked before handling any hazardous material.

ACTIVITY 5:

1. Cite four restrictions concerned with workers conducting activities above other workers.
   a. _____
   b. _____
   c. _____
   d. _____
2. List five types of personal protective equipment that may be used in demolition.
   a. _____
   b. _____
   c. _____
   d. _____
   e. _____

OBJECTIVE 6: Compare major and minor demolition by definition, pre-demolition activities, and structural preparation.

Major demolition is defined as the wrecking or demolishing of any structure over 25 feet in height. Reinforced concrete or steel may comprise its structural support, although many older structures that are major demolition jobs may be structurally supported by other material such as wood. Demolition jobs are also categorized as major when they involve structures that are located next to a building that is to be saved, such as in congested urban areas.

Major demolition jobs can include the full range of industrial, commercial, and residential structures. Bridges, piers, and railroad facilities are major demolition jobs, also. Preparations for major demolition jobs are similar in many respects to those used in minor demolition, but planning of a major demolition job usually involves a much greater effort than that of a

minor demolition. More people and equipment are required, and the job site is usually more congested and potentially more hazardous at a major demolition job. More debris will be produced at a major demolition site, so plans must be made to handle this problem. The difficult task of removing structured steel and reinforced cement requires careful planning, and major demolition jobs usually require the use of chutes to remove debris. Temporary structures to protect adjacent buildings, and shoring to hold the structure up until it is ready to be brought down properly are also required. If the structure can be wrecked by mechanical means, a crane and wrecking ball must be considered. Handling these added dimensions of a major demolition job is a complex process.

As in minor demolition, one of the first steps to be taken at major demolition sites is to restrict the area. This is accomplished by the relocation and/or protection of public thoroughfares with fences, sheds, and barricades, as well as by the posting of signs giving warning of demolition.

Once the area has been restricted, an engineering survey of the structure must be conducted by a properly qualified person experienced in demolition work. This survey should consider all of the planning elements previously discussed, and should result in a determination of the type of demolition to be used to wreck the structure. The condition of all walls, floors, and framing should be reviewed. Adjacent structures must be considered in the planning and property boundaries checked. Necessary permits should be obtained from the local governments and the location of the nearest hospital, first-aid station, police station, and fire station should be noted. A copy of the engineering survey should be at the job site so that it may be referred to as work progresses.

All electric, gas, water, steam, sewer, and other service lines must be shut off, capped or otherwise controlled, either at or outside the building perimeter, before demolition work is started. Any utility company that is involved must be notified in advance, and the necessary approval or services must be obtained. If it is necessary to maintain any power, water, or other utilities during demolition, such lines should be temporarily relocated and protected by barricades or other devices as appropriate.

ACTIVITY 6:

1. List three factors that contribute to the complexity of a major demolition job.
   a. _____
   b. _____
   c. _____
2. Name three pre-demolition activities for major demolition.
   a. _____
   b. _____
   c. _____

OBJECTIVE 7: Describe the special requirements for floor openings, stairs, passageways, ladders, and chutes.

In major demolition jobs, numerous precautions must be taken within the interior of the structure to allow for debris removal and for safe movement of workers.

Debris removal operations conducted inside the walls of a structure are usually accomplished through floor holes. When they are available, existing floor holes such as elevator and ventilation shafts should be used for this purpose. Otherwise, a structural engineer should be consulted prior to cutting floor holes. Floor holes must not take up more than 25 percent of the total floor area on each level (see Figure 6). Support beams are to be left intact wherever possible, and when floors are weakened or made unsafe, they must be shored to carry the intended load from demolition operations.

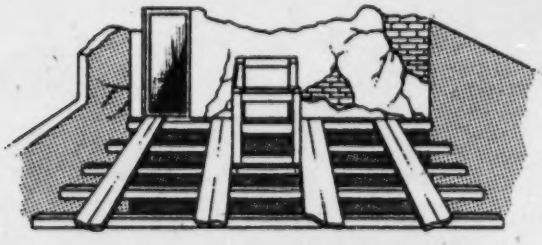

Figure 6. Floors should be opened up to let debris through but sufficient boards should be left for access.

Each entrance to every level with one or more floor openings must be posted with WARNING signs

that indicate the nature of the hazard.

During debris removal, the hole on the uppermost floor from which debris is being dumped should be enclosed by toeboards four inches wide and six inches high. Intermediate floor openings should be barricaded by a substantial railing 42 inches high, that includes a midrail and a toeboard, and is located at least six feet from the opening. Debris cleaning operations on the bottom floor should not begin until all dumping has stopped.

All floor openings that are not being used as material drops must be covered with a material capable of withstanding any load that may be imposed. This cover must be properly secured to prevent its movement, and should be flush with the floor level.

Areas into which debris is dropped that are outside the exterior walls of a structure must be adequately protected to prevent persons from entering. Debris that is dumped a vertical distance of more than 20 feet to the outside of a building must be dropped via a fully enclosed chute. Such chutes should be designed and constructed of sufficient strength to eliminate failure due to impact of materials or debris loaded in them. To this end, a chute should be designed to change direction every 120 feet, and paddles or baffles should be installed as needed. A chute should be adequately secured to its supporting members.

Floor openings must be provided at each level of a chute where debris dumping is anticipated. Openings at all levels except the top floor should be as close to the floor (or other platform) as possible, and extend not more than 48 inches in height. A substantial guardrail approximately 42 inches in height should be provided. Any space between the edge of the floor opening and the chute should be solidly covered. When material is dumped into a chute by means of a wheelbarrow or a mechanical device, a securely-attached bumper, not less than 4 inches thick by six inches wide, should be provided at each opening. Each opening should be provided with a means of closure, and the opening should be kept closed when it is not in use.

The discharge area of a chute must be adequately protected to prevent persons from standing or passing under or near the chute opening. The discharge end of a chute should be provided with a substantial gate, that must be closed when operations are not in progress, and when the receiving truck

or container is being changed. A competent employee should be assigned to control both the operation of the gate and the vehicular traffic in the vicinity of the chute. Under no circumstances should any employee enter a chute for the purpose of clearing accumulated material or debris.

Only those stairways, passageways, and ladders designated as means of access to the structure or building must be used. Other access ways must be entirely closed off at all times. All stairways, passageways, and ladders should be inspected periodically and maintained in a clean, safe condition. When a stairway is used to get to the work area, it must be lighted and covered over at a point not less than two floors below the floor where work is being performed. Passageways should also be lighted and protected.

When ladders are used at the demolition site, they must be free of cracks, splits, and other deformities that would weaken them. They must be free of all oil, grease, dirt, or debris. All ladders must be secured at the top and bottom against slipping. Ladders should extend at least 36 inches above the floor, platform, or other level to which they provide access. The ideal angle at which a ladder is set is 75°, or one foot away from the structure for every four feet of ladder, measured from the ground to the upper support point.

ACTIVITY 7:

(Mark these statements true or false.)

_____ 1. Floor openings for debris removal must cover less than 1/3 of the total floor area.

_____ 2. Chutes must change direction every 200 feet.

_____ 3. Workers should never enter a chute to clear accumulated material.

_____ 4. Ladders must be free of splits, cracks, or deformities.

OBJECTIVE 8: Discuss briefly the removal sequence during demolition.

Once the debris removal preparations have been made, the actual dismantling of the structure may begin. Following the general rule of demolishing a structure in the reverse order to which it was constructed, the roof and walls of the uppermost floor are removed first. Masonry walls or other sections of masonry must not be permitted to fall upon the floor until it has been determined by a qualified person that the floor can safely carry such a load. Any lath work or plaster should be stripped off throughout the building to eliminate dust. Water should be used to reduce dust during this process. If the structure has a steel "skeleton," the steel should be left in place during the removal of the masonry. All loose material should be removed from the skeleton as work progresses downward.

Workers should work from secure scaffolds wherever it is practical to do so. They should never be permitted to work on top of any wall, since this is a dangerous practice. Any wall that is left standing at the end of a shift must be properly shored or braced to prevent premature collapse.

When removing floors, planks of ample strength, not less than two inches by 10 inches in size, should be used by workers who are breaking down the area between the floor beams. Safe walkways should be provided for workers to reach the work area.

ACTIVITY 8:

(Fill in the blank.)

1. Remove walls level by level in _____ order to construction.
2. _____ should be used to reduce dust during stripping of lath work or plaster.
3. Workers should never be permitted to work from the top of a _____.
4. Any wall left standing at the end of a shift must be properly _____ to prevent premature collapse.

OBJECTIVE 9: List debris storage requirements during demolition.

There are several rules that must be followed in the storing of debris on the job site. First, the stability of the structure must be considered. An old building that is already weakened by age, deterioration, or fire may become less stable as demolition progresses, and the extra weight of debris could cause premature collapse. Shoring and bracing of many floor and wall areas may be required, and the storage of debris on any floor must not exceed the allowable floor loads. In structures that have wooden floors, floorboards may be removed from not more than one floor above the curb in order to provide storage space for debris. Falling material must not be permitted to endanger the stability of the structure. In structures made of fireproof construction such as steel, reinforced concrete, or masonry, the floor arches or supports (to an elevation of not more than 25 feet above the curb) may be removed to provide debris storage space. Debris should never be allowed to accumulate against walls, as the lateral pressure its weight imposes could weaken the wall and cause premature collapse. Debris should be removed from the site as soon as practicable while any material that is to be salvaged should be stored in a safe location on the site. All debris storage areas must be blocked off, except for the openings left for debris removal.

ACTIVITY 9:

List debris storage requirements during demolition.

1. _____
2. _____
3. _____
4. _____

OBJECTIVE 10: Describe the process of demolition for steel structures, including the use of mechanical equipment and explosives.

While many structures are demolished by hand, there are other means of bringing a structure down. The use of mechanical equipment and explosives are examples of these different methods of demolition.

Demolition of a steel structure involves the lowering of steel members to the ground by machine. Steel construction must be dismantled column length by column length and tier by tier. The first step in dismantling a steel structure is to unbolt the joints where the members meet, or to cut them with a cutting torch. Workers must be very careful when dismantling these joints because the steel members may be overstressed due to settling or age, and if so, may spring apart when released. When workers are preparing to lower the steel member to the ground, a tag line or guide rope must be used to keep the member from swinging. The hook of the crane line should be placed as near to the center of gravity of the steel member as possible. Since much of the steel taken from a demolished structure is salvaged, an appropriate storage area should be established for this material.

There are numerous types of equipment used in demolition work. They include cranes, dozers, loaders, and backhoes, as well as several different kinds of trucks. Only trained, experienced personnel should operate this equipment. There are several general rules for demolition by machine. No portion of a structure should be demolished by mechanical means, when that portion is more than four times higher than its distance from an area being used by pedestrian or vehicular traffic. When a crane equipped with a clam-shell-type bucket or demolition ball is being used, the bucket or ball must never be swung over the heads of workers on the job site. The weight of the demolition ball must not exceed the recommended limits for the equipment set by its manufacturer, and under no circumstances should a worker be allowed to ride on or to work from a demolition ball or bucket.

Crane operators must follow the directions of a trained signalman when demolishing the structure. When a crane is being operated near power lines, all personnel should exercise extreme care. The local public utility

company should be consulted if any doubt exists as to the presence of power lines and cables.

All dozers, loaders, backhoes, and other debris-removal equipment should be operated by trained personnel and equipped with ROPS (roll-over protection systems) or a canopy. These will protect the worker should the machine roll or tip over. All equipment should have back-up alarms that sound when the equipment is in reverse. During demolition, continuing inspections by an experienced person should be made to detect hazards resulting from weakened floors, walls, or loosened material. Debris from these hazards could fall on a machine. When shut down for the day, all equipment should be parked in a secure area far enough from the structure to prevent damage and the keys should be removed.

The use of explosives to demolish a structure must be done only by a fully qualified and experienced person who is certified to perform such work. Prior to the blasting of any structure, a complete survey of all adjacent structures and underground utilities must be made by a qualified person. When there is a possibility of excessive vibration due to blasting operations, seismic or vibration tests should be taken to determine proper safety limits to prevent damage to adjacent or nearby buildings, utilities, or other property.

The use of explosives to demolish entire buildings is not be permitted unless there is adjacent vacant land in all directions equal to 75 percent of the height of the building being demolished. The use of explosives to demolish smokestacks, silos, or similar structures is permitted as long as the direction of the fall contains a minimum 90° of open space extended outward at least 150% of the height of the structure.

All workers must be cleared from the job site area prior to blasting. There should be an adequate audible system in use to give warning before firing and when danger has passed. A preliminary warning, allowing time for the danger zone to be cleared of workers prior to firing, should be given, followed by an immediate (final) warning, indicating that firing is imminent. Firing should take place immediately after the final warning.

Warning signals should be given only under the direction of the competent person in charge of the operation, who should ensure that the area is clear of

personnel before he or she gives the final signal to the shot firer. These signals should be easily distinguishable. Signal flags, look-outs, and notices explaining warning systems should be posted at all approaches.

Precautions should be taken to protect other properties from shock and vibration, and flying debris should be controlled by means of blast mats or baffles. The charges should be fired only when all safety precautions have been observed.

ACTIVITY 10:

(Choose the correct answer.)

1. All of the following are safe and/or established practices for demolition of a steel structure except:
   a. Steel construction must be dismantled column length by column length and tier by tier.
   b. The joints where members meet must be unbolted or cut.
   c. The hook of the crane line should be attached to the end of the steel member.
   d. A tag line should be used to guide the steel member to the ground.
2. Demolition safety depends upon:
   a. A fully qualified, experienced, certified person to perform the work.
   b. An audible alarm system.
   c. A careful pre-demolition survey.
   d. Use of mats or baffles.
   e. All of the above.

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U.S. Department of Labor. Safety Standards for Federal Installations. Washington, DC: 1952.

ANSWERS TO ACTIVITIES

ACTIVITY 1

1. False.
2. False.
3. False.
4. True.

ACTIVITY 2

1. Restriction of the area and protection of thoroughfares.
2. Engineering survey.
3. Location and protection of utilities.

ACTIVITY 3

2
1
5
4
3

ACTIVITY 4

1. a. The floors could become overloaded, leading to premature collapse.
   b. Debris constitutes a tripping and falling hazard.
2. a. Chutes.
   b. Floor holes.

ACTIVITY 5

1. a. Take extra care when work is being conducted on several work levels.
   b. Do not let debris accumulate on work platforms.

c. Construct a canopy over entrances to protect workers from falling debris.

d. Provide fall protection for workers.

2. (Any five.)

a. Face and eye protection — safety glasses, goggles, and face shields.

b. Hard hats.

c. Safety shoes.

d. Welding goggles and helmets.

e. Respirators.

f. Safe work clothes.

ACTIVITY 6

1. a. The structure is: over 25 feet high.

b. Made with reinforced concrete.

c. Often next to a structure to be saved.

2. a. Restrict the area.

b. Engineering survey.

c. Contact utilities.

ACTIVITY 7

1. False.
2. False.
3. True.
4. True.

ACTIVITY 8

1. Reverse.
2. Water.
3. Wall.
4. Shored/braced.

ACTIVITY 9

1. Determine stability of structure.
2. Do not allow debris to accumulate on floors or against walls.
3. Remove debris from site as soon as practical.
4. Set up special storage area for salvageable material.

ACTIVITY 10

1. c.
2. e.